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Forest Pest Management Report

R-3 85-1

BIOLOGICAL EVALUATION
Effects of Soil Fumigation on
Soilborne Plant Pathogens and Seedlings
at the Albuquerque Tree Nursery

Cibola National Forest
New Mexico

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USDA Forest Service, Southwestern Region
State and Private Forestry
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SUMMARY

The Albuquerque Tree Nursery (ATN) annually fumigates seedbeds with methyl bromide and chloropicrin at an average rate of 350 pounds per acre for the purpose of suppressing potential soilborne plant pathogens, weeds, and nematodes. Since 1979, Forest Pest Management has evaluated the effectiveness of the annual fumigation in reducing population levels of various species of Fusarium and Pythium.

Block 8 was fumigated during the week of April 30-May 4, 1984, using the alternate strip method. Prefumigation Fusarium spp. population levels averaged 400 propagules per gram (ppg). Block 8 had also been fumigated and planted in 1982, and prefumigation Fusarium population levels at that time averaged 1,584 ppg. Fusarium levels were reduced significantly after fumigation; 111 ppg in 1984 and 47 ppg in 1982. Pythium spp. population levels were low before fumigation and were significantly reduced after fumigation. Seedling survival was significantly lower in the unfumigated plots than in the fumigated areas at the end of the growing season (October).

Three sections in block 1 and one section in block 2 were fumigated and prepared for sowing in July to supplement production seedbeds and to continue testing the feasibility of summer planting. Pre- and post-fumigation and end-of-season soil samplings were conducted for Fusarium spp. and Pythium spp. to determine population levels.

Table 4 illustrates the pre- and post-fumigation population levels of Fusarium spp. and Pythium spp. from 1979 through 1984.

METHODS

Prefumigation soil sampling was conducted in block 8 on April 24, 1984, specifically to assay species of Fusarium and Pythium. Sections 1 through 17 of block 8, approximately 8 acres, were sampled by walking the length of each section and inserting a soil core extractor 4 to 6 inches into the soil at 20-foot intervals. Collected soil cores were mixed and each was placed in a separate bag labeled with the appropriate section number and collection date. Fusarium and Pythium spp. isolations were performed using standard soil dilution plating techniques and selective media for Fusarium and Pythium spp. (refer to Biological Evaluation R-3 83-10). Postfumigation soil sampling was conducted on June 7, 1984, and end-of-season soil sampling was conducted on October 10, 1984, in block 8, sections 2 through 13, using the same techniques.

Fumigation effects on seedling survival were determined by establishing three unfumigated plots in block 8. In the selected sections (3, 5, and 7), the fumigation crew was instructed to establish plots, each 16 by 44 feet, oriented east-west. These plots were located approximately 150 feet from the north end of the block. Corners of unfumigated plots were marked with flagging. Areas immediately adjacent to the unfumigated plots served as fumigated plots.

Seedling density estimates, comparing fumigated with unfumigated areas, were made by placing a 1- by 4-foot frame across each bed in the selected sections, and counting the live seedlings contained therein. Estimates were made on June 22, 1984, at the beginning of the growing season and on October 19, 1984, at the end of growing season.

RESULTS AND DISCUSSION

Prefumigation soil sampling in block 8 showed that levels of Fusarium averaged 400 ppg. Block 8 was fumigated during the first week of May 1984, and postfumigation soil sampling indicated that the Fusarium population level was significantly reduced (111 ppg; $P = 0.05$). Propagule density had increased by the end of the growing season to approximately 218 ppg (table 1 and figure 1).

Pythium spp. were found to be at a low level before fumigation ($\bar{x} = 4$ ppg) and were significantly reduced by the fumigation ($\bar{x} = 1$ ppg). At the end of the growing season, Pythium population levels were the same as they were immediately after fumigation (1 ppg) (table 1 and figure 1).

Block 8 was sown to provide 40 viable seedlings per square foot. Seedling density was higher in fumigated soils than in unfumigated soils; 36 seedlings versus 31 seedlings on June 22, 1984, and 32 versus 14 on October 10, 1984; neither difference was significant (table 2 and figure 2).

Sections 18, 28, and 51 of block 1 and section 2 of block 2 were fumigated on July 2 and planted on July 23, 1984 (the second year of a summer planting feasability study). Prefumigation soil sampling conducted on June 13, 1984, in blocks 1 and 2, showed that levels of Fusarium averaged 4,633 ppg and Pythium averaged 1 ppg. Postfumigation soil sampling conducted on July 17, 1984, showed that both Fusarium and Pythium population levels were lowered (33 ppg and 0 ppg, respectively). At the end of the season (October 10, 1984), Fusarium population levels had risen slightly (100 ppg) and Pythium population levels had remained the same (0 ppg) (table 2 and figure 3). No seedling counts were conducted in blocks 1 and 2.

CONCLUSIONS AND RECOMMENDATIONS

The benefits gained from fumigation of block 8, namely the reduction of Fusarium population levels and the higher seedling survival rate, more than justify the expense of fumigation (refer to Biological Evaluation R-3 83-10) and seedbed fumigation should continue at the present levels.

TABLE 1.--Means and standard errors of *Fusarium* and *Pythium* populations (block 8, sections 2 through 13)

	Fusarium spp.		*Pythium* spp.	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Prefumigation	400	96	4	1
Postfumigation	111	67	1	0
End of season	218	41	1	0

TABLE 2.--Means and standard errors of *Fusarium* and *Pythium* populations (block 1, sections 18, 28, and 51, and block 2, section 2)

	Fusarium		*Pythium*	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Prefumigation	4,633	1,013	1	1
Postfumigation	33	33	0	0
End of season	100	64	0	0

TABLE 3.--Means and standard errors of seedling densities (trees per square foot) (block 8, sections 3, 5, and 7)

		$\bar{x}$	$s_{\bar{x}}$
June	Unfumigated	31	5
	Fumigated	36	6
October	Unfumigated	14	6
	Fumigated	32	4

TABLE 4.--Pre- and post-fumigation population levels of *Fusarium* and *Pythium* (1979-1984) (propagules per gram)

		Pre	Post
1979			
Block 3	*Fusarium*	20,190	9,328
	Pythium	8	5
Block 4	*Fusarium*	6,162	10,060
	Pythium	13	6
1980			
Blocks 3 & 4	*Fusarium*	4,240	1,829
	Pythium	12	1
1981			
Block 1	*Fusarium*	1,543	53.33
	Pythium	6	1
1982			
Block 7	*Fusarium*	2,698	149
	Pythium	2	1
Block 8	*Fusarium*	1,584	47
	Pythium	3	1
1983			
Block 5	*Fusarium*	2,952	66.67
	Pythium	2	0
Block 1	*Fusarium*	6,033	133
	Pythium	--	--
1984			
Block 8	*Fusarium*	400	111
	Pythium	4	1
Blocks 1 & 2	*Fusarium*	4,633	33
	Pythium	1	0

Figure 1.--MEAN POPULATIONS OF FUSARIUM & PYTHIUM AT THE ALBUQUERQUE TREE NURSERY

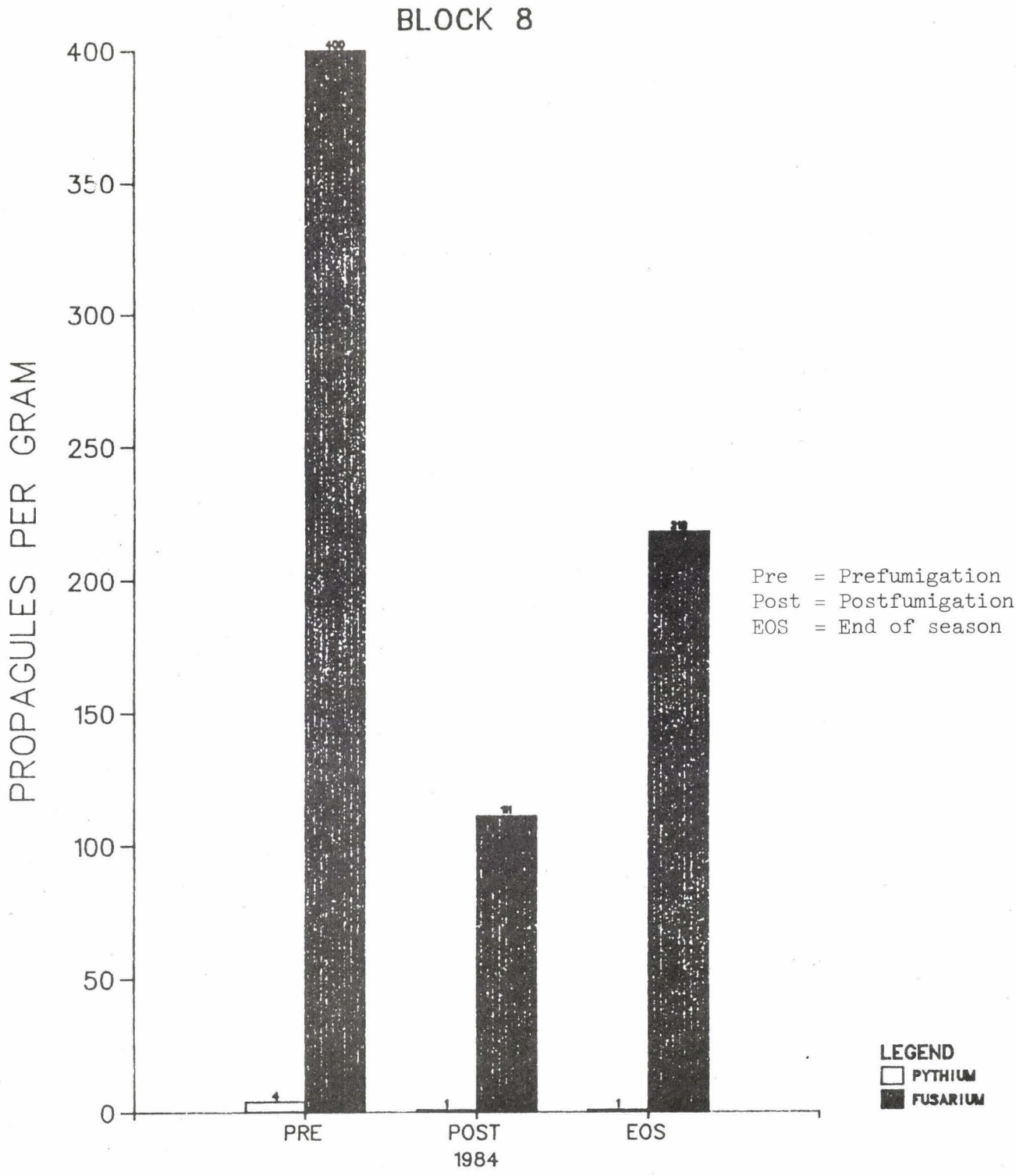

Figure 2.--MEAN TREE DENSITIES
AT THE ALBUQUERQUE TREE NURSERY

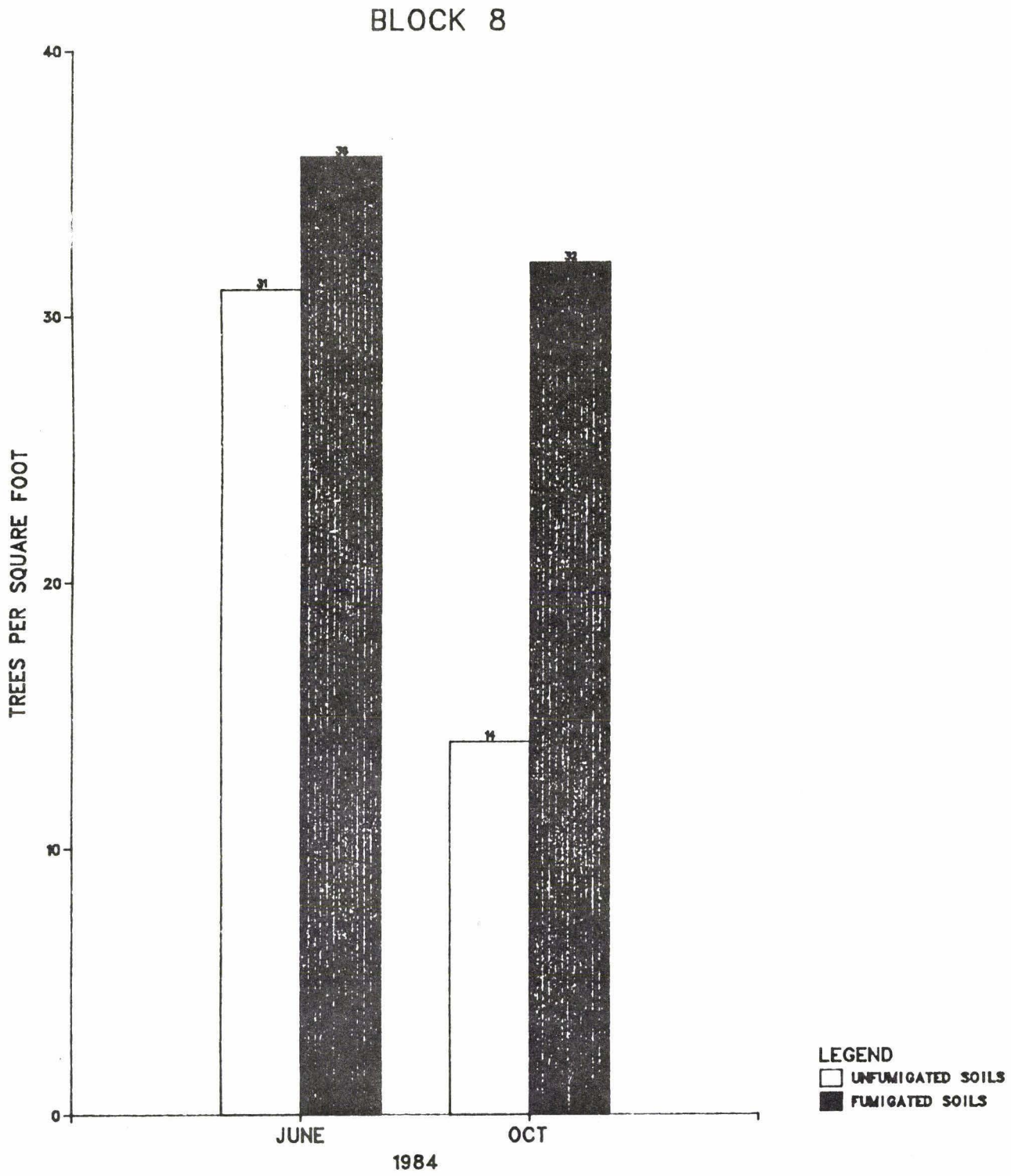

Figure 3.-- MEAN POPULATIONS OF FUSARIUM & PYTHIUM AT THE ALBUQUERQUE TREE NURSERY